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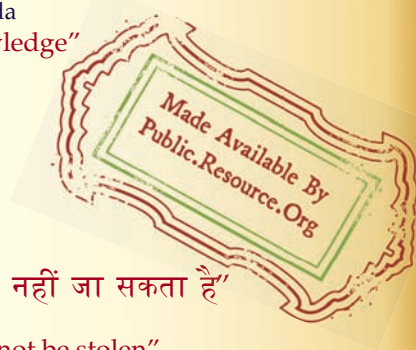
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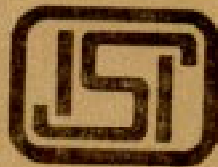
Indian Standard

SAFETY REQUIREMENTS IN ELECTRO-HEAT INSTALLATIONS

PART II PARTICULAR REQUIREMENTS FOR RESISTANCE HEATING EQUIPMENT

Section 2 Protection in Indirect Resistance Heating Installations

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*Indian Standard***SAFETY REQUIREMENTS IN
ELECTRO-HEAT INSTALLATIONS****PART II PARTICULAR REQUIREMENTS FOR
RESISTANCE HEATING EQUIPMENT****Section 2 Protection in Indirect Resistance
Heating Installations**

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Indian Standard

SAFETY REQUIREMENTS IN ELECTRO-HEAT INSTALLATIONS

PART II PARTICULAR REQUIREMENTS FOR RESISTANCE HEATING EQUIPMENT

Section 2 Protection in Indirect Resistance Heating Installations

0. FOREWORD

0.1 This Indian Standard (Part II/Sec 2) was adopted by the Indian Standards Institution on 18 December 1980, after the draft finalized by the Industrial Electro-heating Equipment Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 This standard forms Section 2 of Part II covering the requirements for protection in indirect resistance heating installations. The other parts of the series are as follows:

Part I General requirements

Part II/Sec 1 Protection in direct resistance heating installations

Part II/Sec 3 Protection in potassium and sodium nitrate and nitrite bath furnaces

Part II/Sec 4 Protection in installations used for drying varnishes and other similar products

Part III Particular requirements for mains and medium frequency induction furnace installations

0.3 In preparing this standard considerable assistance has been derived from IEC Publication 519-2 (1975) ' Safety in electro-heat installations: Part II Particular requirements for resistance heating equipment ' issued by the International Electrotechnical Commission.

0.4 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (revised).

1. SCOPE

1.1 These particular requirements apply to equipment for indirect resistance heating of a charge, such equipment being energized with dc or with single-phase or polyphase ac of low frequency.

In such equipment, heat is generated by current flow in:

- a) solid metallic heating conductors (iron, nickel, chromium, aluminium, copper, platinum, molybdenum, tungsten, or alloy of these different metals);
- b) solid non-metallic heating conductors (silicon carbide, carbon or graphite . . . in the form of rods, tubes or in granulated form).

1.2 From the different types of electric furnaces generally used, the following may be mentioned.

- a) Batch-type furnaces (for example, box-type furnaces, pot furnaces, bell type furnaces, bogie-hearth furnaces);
- b) Furnaces for heating in transit (continuous furnaces) or passage furnaces (for example roller-hearth furnaces, pusher furnaces, walking-beam furnaces, rotary kilns, rotary-hearth furnaces, tunnel kilns); and
- c) Melting and holding furnaces (for example crucible furnaces, pot furnaces, rotary furnaces).

1.3 Other industrial type equipment with resistance heating system include:

- a) equipment for heating liquids and gases;
- b) equipment for heating moulds, rollers of rolling-mills, tools, etc;
- c) equipment heated by infra-red emitters for industrial purposes; and
- d) equipment heated by individual heating elements of various types.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Batch-Type Furnaces — Furnaces in which a solid charge is stationary and undergoes no movement during heating, temperature holding and cooling.

2.2 Furnaces for Heating in Transit (Passage Furnaces) — Furnaces in which a solid charge is displaced continuously or intermittently during heating, temperature holding and cooling.

2.3 Melting Furnaces — Furnaces used for melting solid charges.

2.4 Holding Furnaces — Furnaces used for maintaining in the liquid state charges introduced in the liquid state.

2.5 Bath Furnaces — Furnaces in which the charge is heated by its immersion in a liquid medium at working temperature.

2.6 Heating Elements (for Example Heating-Element Assemblies) — Resistors are the components of the equipment which transform electric energy into heat. When resistors are designed to be integral with their refractory support, the assembly is called the 'heating element'.

2.7 Removable Elements (for Example, Removable Heating-Element Assemblies) — Conventionally, a resistor is said to be 'easily removable' when it can be removed or replaced by the user independently of any other component of the furnace (thermal insulation or refractory). When the replacement can be carried out without interrupting the operating process, the resistor is said to be 'removable in service'.

NOTE — The same definitions shall apply to heating elements.

3. CONSTRUCTION AND INSTALLATION DETAILS

3.1 Voltage Values — Attention is drawn to high values of the leakage current which may appear, in consequence, measures should be taken for protection against indirect contact [see IS : 9080 (Part I)-1980*].

3.1.1 In these conditions, rated voltages reaching 420 V between phase and earth and 420 V between phases can be applied if the equipment is earthed.

3.1.2 Rated voltages over 400 V but not exceeding 500 V can be applied if special measures are taken to exclude any hazards which may arise during operation due to an involuntary contact with a live element.

3.1.3 In some exceptional cases, for example for heating air or gas, rated voltages exceeding 500 V can be used provided that minimum air clearances as specified in relevant Indian Standards for the construction of apparatus operating at voltages above 1 kV are observed for heating elements and their connections.

3.2 Nameplates and Wiring Diagram

3.2.1 For equipment having its own variable voltage source (transformer or generator), it is necessary, when the resistance of heating elements varies considerably with temperature, or due to ageing or wear,

*Safety requirements in electro-heat installations: Part I General requirements.

that the nameplate indicating the power of the equipment shall give the following values:

- a) Rated current;
- b) Installed power of the voltage source, instead of the respective furnace data; and
- c) Working temperature.

If the power absorbed by the equipment in the cold state exceeds by more than 30 percent that absorbed at rated power, it shall also be mentioned on the nameplate.

This does not apply to equipment heated at reduced power.

3.2.2 Spare heating elements shall, preferably, be marked indelibly, or, if this is impossible, they shall be provided with labels specifying the type, the rated voltage and the rated power.

3.2.3 The wiring diagram may be supplied separately by the manufacturer to the user.

3.3 Protection Against Accidental Contacts — Furnaces or equipment provided with unprotected conductors at voltages above Band 1, which, after the opening of the door or of any other closing device (such as a lid) may be touched accidentally either by hand or with tools, shall be equipped with a door contact which, by means of a relay, switches off the heating conductors when the door is open.

For equipment which is required to remain in operation during short though frequent periods and during which the door may be open (for instance in enamelling furnaces, forge furnaces, hearth furnaces for melting light metals, etc), particular care should be given to the earthing of charging devices which are introduced inside the furnace and to the protection of operators (suitable shoes, gloves and a dry working site). Furthermore, personnel should be warned by display of ' Danger ' warning notices.

If for other furnaces also, such as furnaces for heating in transit or passage furnaces, it is impossible, because of their method of operation, to provide door circuit-breaker as a measure of protection against possible contact with a bare heating conductor, clearly visible warning notices shall be placed near service openings or other provisions made to indicate that the heating conductors are live.

This applies to furnaces in which the earthing of components, removable from the furnace, is disconnected before the voltage is switched off by contacts. This may also be the case in pot furnaces where the removable tank at the same time constitutes the closing of the furnace where no other special lid has been provided.

3.4 Overheating — Where because of:

- a) insufficient care;
- b) accidental switching-on;
- c) fault of the control equipment or of the temperature limiting device (*see* Note 1); and
- d) operation without control equipment or without the temperature limiting device:

the (internal or external) temperature either of the furnace or of the electro-heat installation could attain a value likely to cause danger in the vicinity of these installations, measures should be taken to operate:

- i) an alarm device for supervised furnaces, and
- ii) an automatic cut-out with an alarm device for other furnaces.

NOTE 1 — The hazard due to a fault in the temperature control system or limiting device can be reduced either by equipping the temperature controller with an over-temperature contact or by using a thermo-electric controller provided with a thermal protection against breaking. Another solution consists of providing a second independent temperature limiter (for example a second controller, a cut-out, etc).

NOTE 2 — Temperature control and limiting systems can be omitted only if the operating personnel have made the necessary arrangements or if the heating power has been determined as a function of furnace losses so that a dangerous temperature cannot be attained.

3.5 Auxiliaries — Measures shall be taken to prevent auxiliaries, such as transport and charging devices, from constituting a source of additional hazard.

4. OPERATION

4.1 Unprotected heating elements supplied at voltages exceeding Band 1 shall be located in a manner that renders their contact with the heated charge impossible during operation. When media representing a sufficiently high electric resistance are heated, the latter can be in

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contact with heating elements provided, however, they cause no mechanical damage.

4.2 Suitable measures should be taken to avoid hazards due to leakage current flowing through the media.

4.3 If, during operation, the charge emits vapours or if precipitations or sediments, etc, occur, account shall be taken of chemical and thermal effects which could affect the heating elements.